

MP MASTER

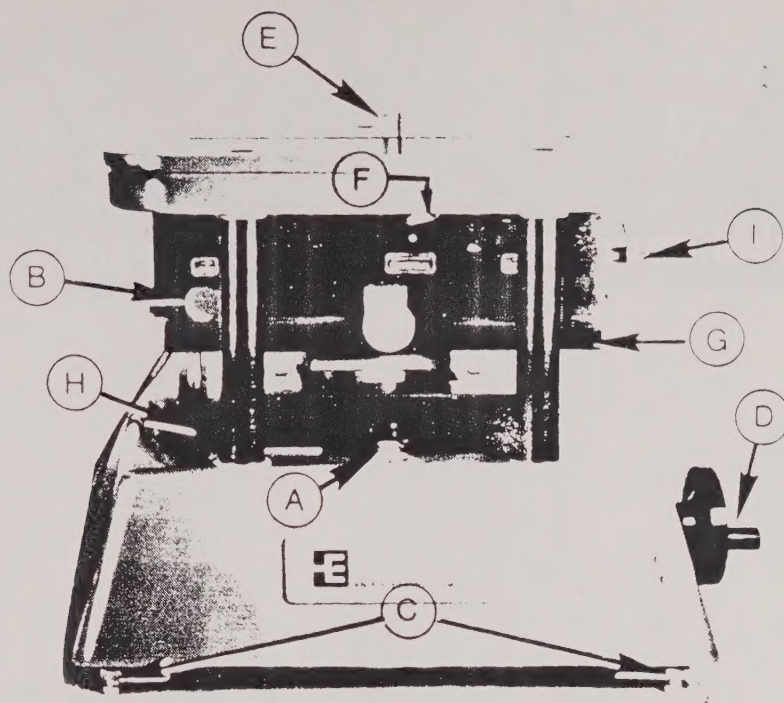


MA33350



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- A LEVEL VIAL
- B LOCKING JAW KNOB
- C LEVELING FEET
- D JAW ELEVATING WHEEL
- E REFERENCE JAW (LEFT JAW)
- F REVERSING LEVER (INTERNAL - EXTERNAL)
- G CENTRALIZING KNOB (UNDER F)
- H SWIVEL ADJUSTMENT
- I SENSITIVITY JAW ADJUSTMENT (RIGHT JAW)

APPENDIX TO FEDERAL RING COMPARATOR PROCEDURE

Model 136B-5 Master Ring & Disc Comparator

Much more master comparator for much less money!



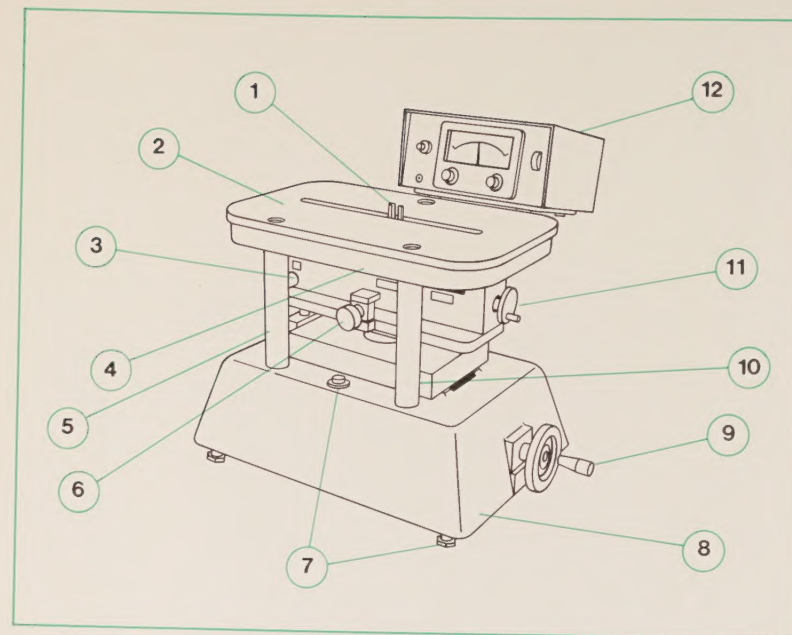
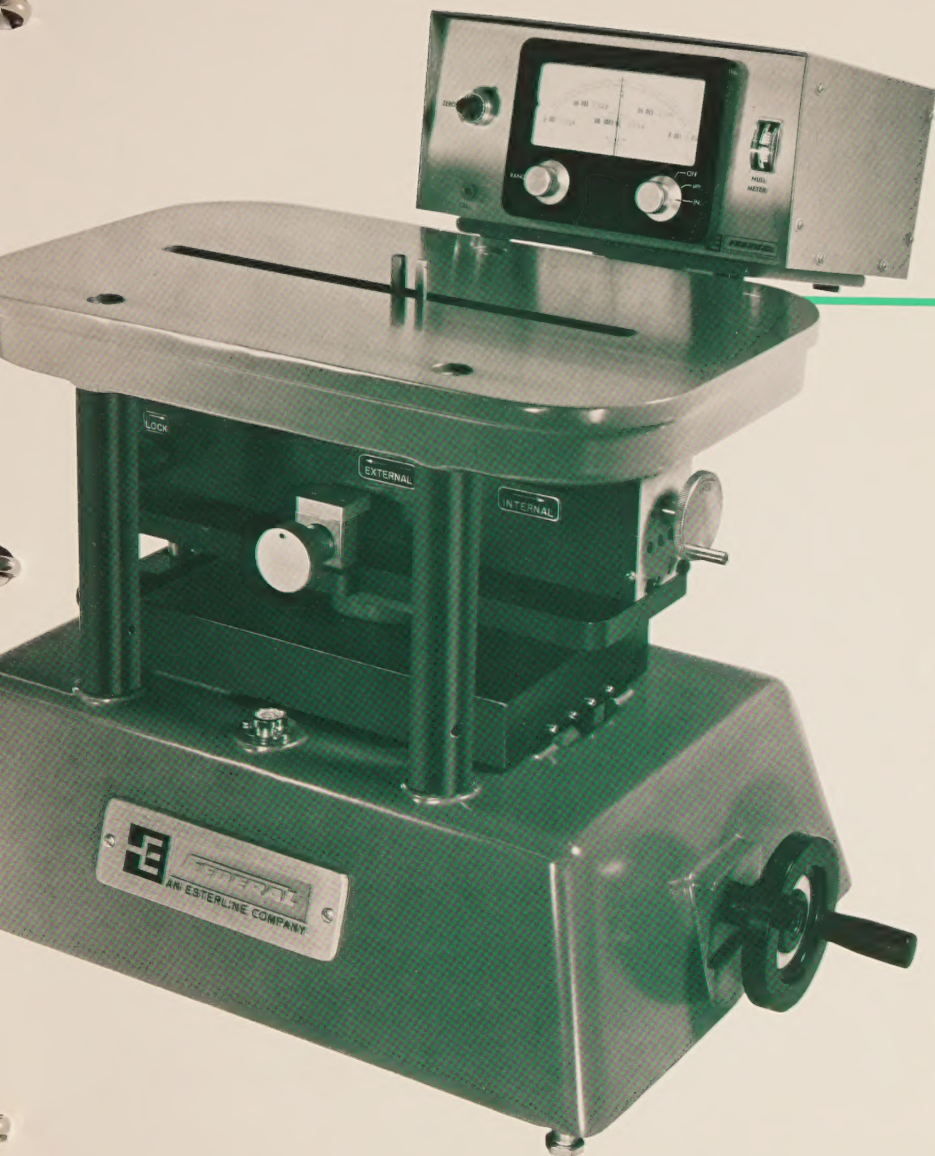
For high magnification inspection of class X master rings and discs.

Model 136B-5

Master Ring and Disc Comparator

The same expertise in gage design that made Federal's millionth class comparators the standard of the industry has also been applied to the Model 136B-5 Master Ring and Disc Comparator. Combining superior quality with an attractive price, unmatched by any other master comparator, Model 136B-5 is more than equal to them all in capacity, range, magnification and accuracy. And it provides many exclusive extra features, like:

- a positive, precision jaw lock that assures the same measuring force for setting to gage blocks and checking the work — eliminates jaw deflection as a gaging influence;
- “click-scale” choice of five magnifications at the turn of a knob — minimum graduations as fine as $.000005''/0,1 \mu\text{m}$;
- a centralizing control knob for smooth, precise positioning of the measuring jaws on true diameter of the work;
- a swivel control for rotating jaws in gage block set ups to locate null point quickly and easily.



1. Carbide-tipped jaws are mounted on frictionless reed springs for sensitive response. Seven pairs of jaws cover all I.D. measurements from .040" to 12"/1 mm to 305 mm and O.D. measurements from 0 to 10.750"/0 to 273 mm.

2. Large reference table of fine grained, stress-relieved cast iron is precision ground. Rigidly controlled assembly assures parallelism between table surface and axis of contact points.

3. Jaw lock helps to assure that the same gaging force achieved when setting up with gage blocks is exactly duplicated when measuring the work, thus eliminating jaw deflection as a gaging factor. Gaging mechanism is kept in null position, as indicated on amplifier's null meter, for both setup and measurement.

4. Reversing lever (not visible) for changing from I.D. to O.D. measurement.

5. Swivel control (not visible) rotates jaws in horizontal plane to locate the null point when setting up with gage blocks.

6. Centralizing control accurately positions jaws front to back so that gaging contacts locate on the true diameter.

7. Level indicator and leveling screws. Three adjustable feet provide accurate, no-lift support.

8. Normalized cast iron base supports gaging mechanism securely, dampens vibrations.

9. Jaw elevation wheel for feather light control when exploring work. Counter-balanced mechanism and precision fits permit easy setting of elevation through more than 1 1/2"/38 mm range without side shift.

10. Three heavy-duty columns provide rigid support for reference table.

11. Sensitive jaw adjustment for setting size quickly and easily.

12. Field proven "432" Series Amplifier features a linear scale which can be mastered anywhere within its range; rapid response with no overshoot; fine-line graduations and needle-thin pointer to provide high resolution for positive readings.

"Click-scale" arrangement provides choice of five magnifications with minimum graduations as fine as .000005"/or 0.1 μ m. A turn of the selector switch changes scale numerals to suit magnification chosen, eliminating the confusion of multiple scales and graduation values.

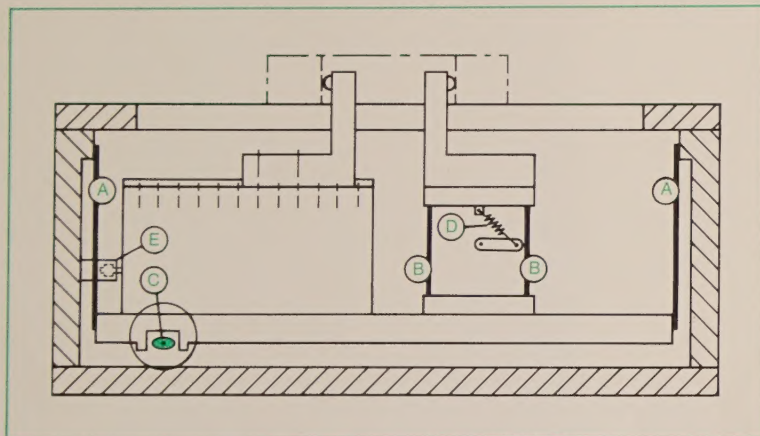
Electrical zero adjustment permits quick, accurate fine adjustment. The control provides both ample range and very close control over exact zero setting.

Amplifier has an output connection for operation of specialized read-out devices and may also be unplugged from the comparator and used with regular Federal "Multi-Choice" Electronic Gage Heads for other gaging applications. The amplifier is equipped with polarity reversal switch for use in this type of operation.

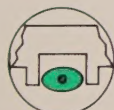
Millionth Accuracy — How It's Achieved

Seemingly insignificant details become extremely important when dealing with comparative measurement of master rings, discs and other fine tolerance work to laboratory accuracies. Such factors as friction and jaw deflection must be carefully considered in the design and operation of the gaging equipment to be used. Since it is virtually impossible to completely eliminate these variables, they must be controlled as closely as possible to

neutralize their adverse effects on measurement accuracy. The measuring forces that are present when mastering the gage must be precisely duplicated when checking the work. To insure this repeatability of gaging forces, Model 136B-5 Master Comparator uses a full floating, frictionless reed spring mechanism in combination with a jaw lock and an electronic null transducer.



Detail 1.



Detail 2.



Detail 3.

How It Works

One set of reed springs (A) directly supports the reference jaw; a second set of reed springs (B) supports the sensitive jaw. This forms a frictionless, "floating" gaging unit whose jaws are free to move in unison to accommodate the position of the work being checked and free to move separately for determining workpiece size.

During setup, the jaw lock is set on "Lock", with cam (C) turned as illustrated in Detail 1. This holds the reference jaw in a fixed location and subjects it to a controlled gaging force, provided by spring (D), for all subsequent readings.

The gage block stack or master, when properly positioned against the measuring jaws, will exert just enough force to overcome the spring tension, allowing the gaging unit to "float" free of the cam (Detail 2). The gaging forces present distribute themselves equally between the two jaws and the

gaging unit centralizes itself at its "null" or balance point. This is the only condition at which the built-in electronic null transducer (E) will read "zero".

To further verify that true null conditions have been established, there will be no shift in either the amplifier or null meter readings when the jaw lock is turned to its "Unlock" position (Detail 3), indicating that the gaging forces are indeed equalized.

The same basic procedure is followed in measuring the work. With the aid of the jaw lock and the null transducer, the same null conditions are quickly and easily re-established. The same gaging forces present during setup are precisely duplicated for checking the work. Thus, variable factors such as friction and jaw deflection are eliminated as gaging influences — the amplifier reading represents only the actual size deviation of the work being checked ... to true millionth accuracy.

Specifications

Comparator Base	Normalized Cast Iron 19 1/2" x 14" x 5 1/2" 495mm x 356mm x 140mm not including adjustable feet
Reference Table	Normalized Cast Iron 18" x 11 1/4" / 457mm x 286mm
Maximum Jaw Elevation	.1% / 41mm
Gaging Force	.50g

Measuring Range — Inch

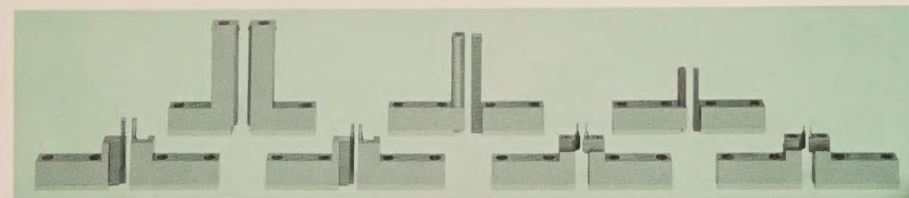
Range	Minimum Graduation	Magnification
±.005"	.0005"	220X
±.002"	.0001"	1100X
±.001"	.00005"	2200X
±.0002"	.00001"	11,000X
±.0001"	.000005"	22,000X

*±.010" when amplifier is used with other gage heads.

Price information in separate price list; delivery information on request.

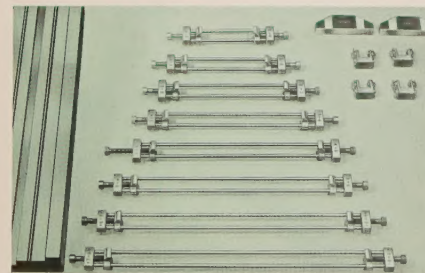
We reserve the right to change product design, specifications and prices without notice.

Jaws



Part No.	Measuring Capacity	Maximum Measuring Depth
EJW-1002	0 to 10.750" / 0 to 273mm O.D.	1.693" / 43mm
EJW-1003	1.375" to 12.000" / 35mm to 305mm I.D.	1.375" / 35mm
EJW-1004	.365" to 1.375" / 9.3mm to 35mm I.D.	.690" / 17.5mm
EJW-1005	.240" to .390" / 6.1mm to 10mm I.D.	.382" / 9.7mm
EJW-1006	.130" to .275" / 3.3mm to 7mm I.D.	.185" / 4.7mm
EJW-1007	.098" to .157" / 2.5mm to 4mm I.D.	.170" / 4.3mm
EJW-1008	.060" to .115" / 1.5mm to 3mm I.D.	.110" / 2.8mm
	.040" to .078" / 1mm to 2mm I.D.	

Gage Block Alignment Assembly



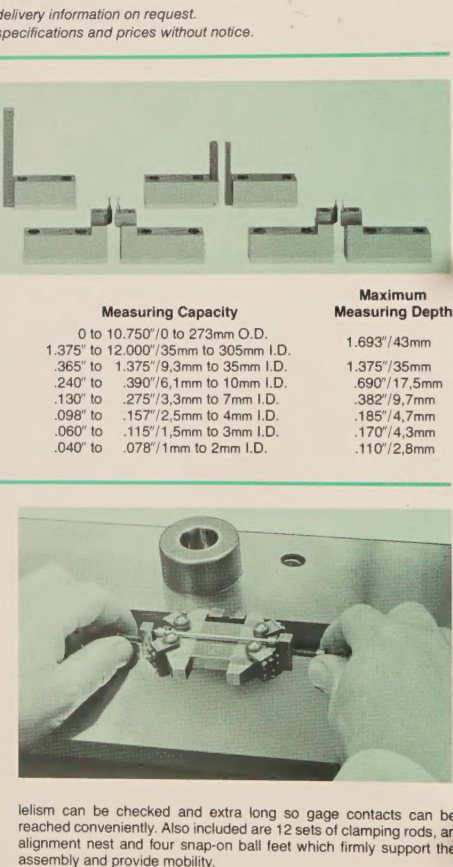
A specially designed Assembly (EAT-1005) is available to hold gage block stacks in proper alignment and permit closely controlled positioning across the measuring jaws. The complete assembly includes high precision caliper blocks which are double ended so stack paral-

Power Requirements	7 watts 117V ± 10%, 50-60 Hz or 220V ± 10%, 50-60 Hz by switching internal jumpers
Range of Zero Adjustment — Amplifier	±.002" / 50 μm
Dimensions	10 3/4" x 8 1/2" x 5 1/4" 273mm x 216mm x 133mm
Weight	.252 lbs. / 113kg

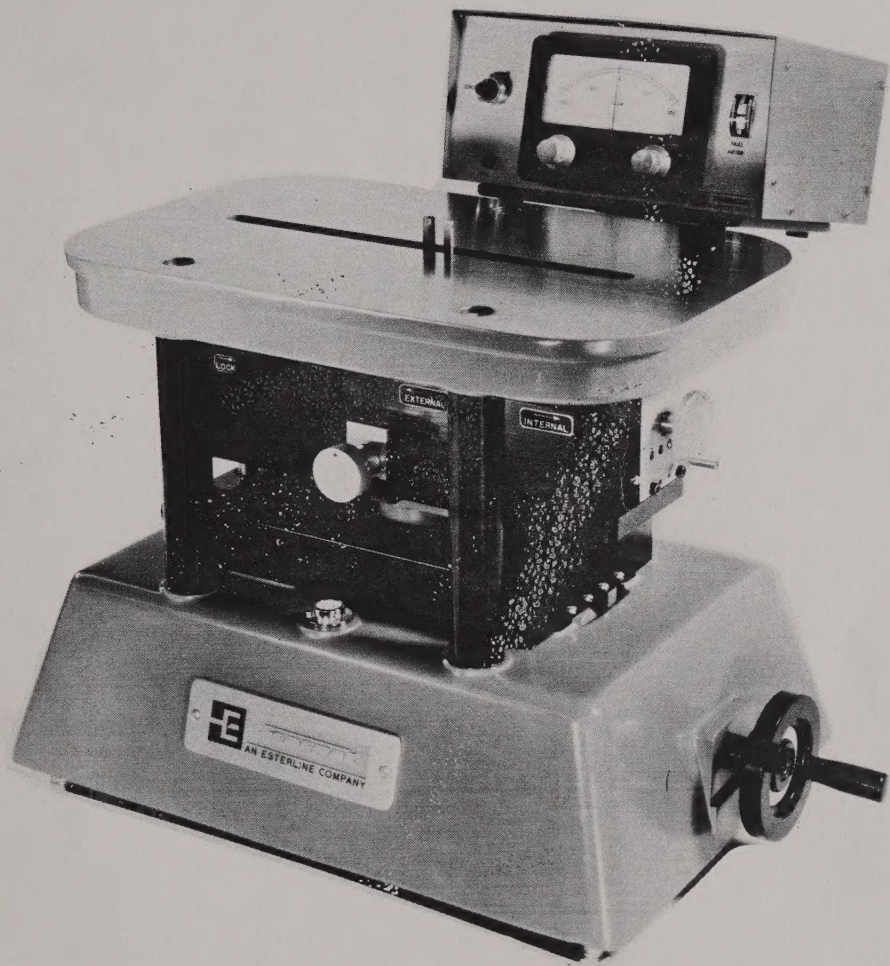
Measuring Range — Metric

Range	Minimum Graduation	Magnification
±100 μm*	10 μm	275X
±40 μm	2 μm	1375X
±20 μm	1 μm	2750X
±4 μm	0.2 μm	13,750X
±2 μm	0.1 μm	27,500X

*±200 μm when used with other gage heads.



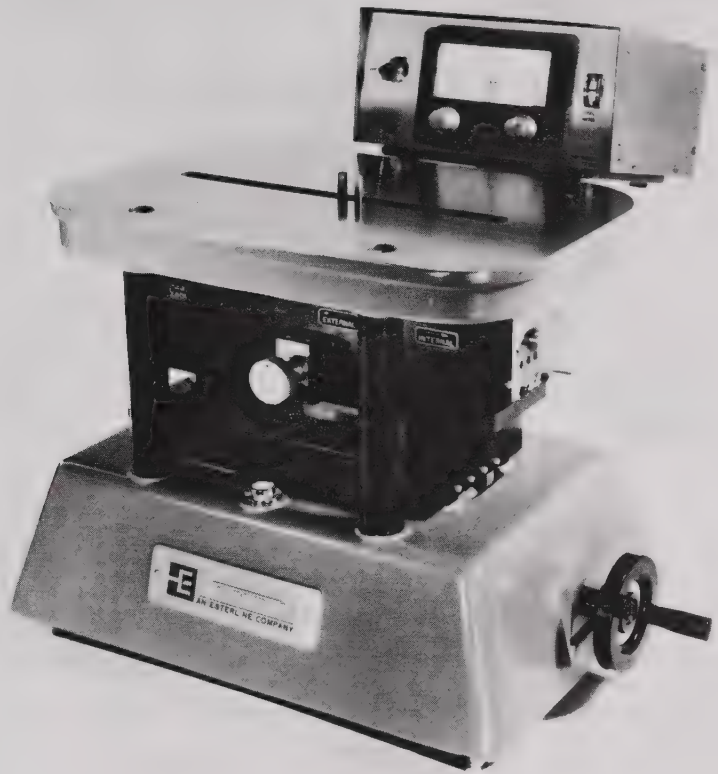
leism can be checked and extra long so gage contacts can be reached conveniently. Also included are 12 sets of clamping rods, an alignment nest and four snap-on ball feet which firmly support the assembly and provide mobility.



OPERATING INSTRUCTIONS
for
HORIZONTAL MASTER COMPARATOR
Model 136B-5

CONTENTS

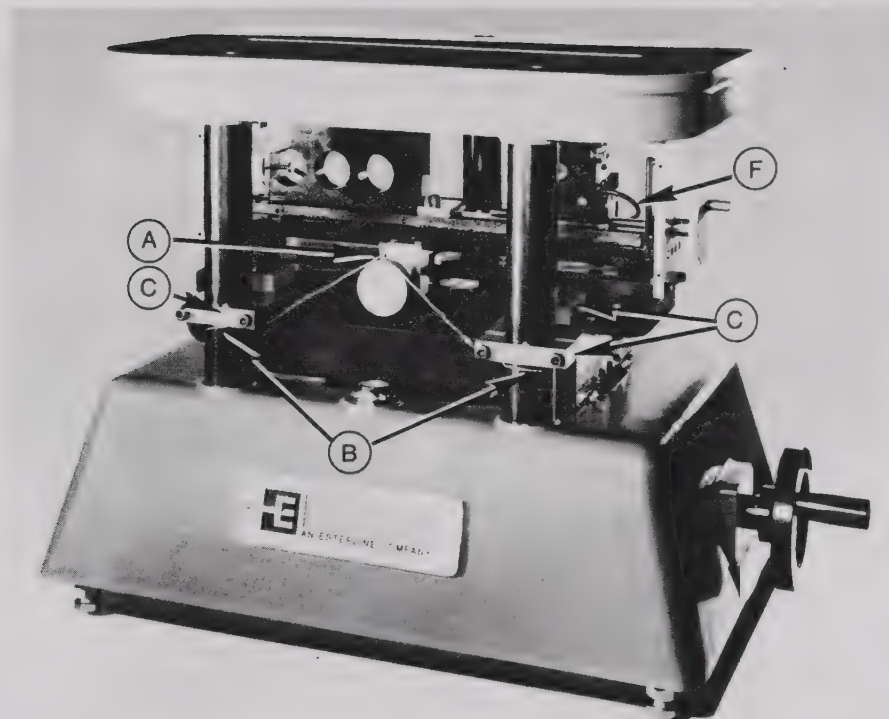
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DESCRIPTION

The Federal 136B-5 is an electronic, horizontal, bench type comparator for high magnification inspection of class X master rings, plugs and discs. It incorporates a large, precision ground reference table and a free floating, frictionless gaging unit mounted on a normalized cast iron base. Adjustable controls include a precision elevating mechanism for exploring master I.D.'s and O.D.'s and a swivel mechanism for accurately centralizing the gaging jaws at a null position.

A Series "432" solid state amplifier, having five selectable scales of magnification provides high resolution, multi-range readout. A built-in electronic null transducer, in combination with a gaging jaw lock, eliminates jaw deflection as a gaging factor. For a complete description of Model 136B-5 with specifications, refer to brochure (A-986) enclosed with these instructions.



SETUP AND
OPERATION
IMPORTANT

Figure 1. Model 136B-5, Front View.

As a precaution against damage to comparator mechanisms during shipping or prolonged storage, reinstall all plates and braces and repack gage in its original storage crate.

Preliminary
Steps

Refer to Figure 1. Carefully unpack comparator and remove front and back cover plates. From front of gage, remove wire and screw from Centralizing Knob (A) and front table support posts (B). Then, remove two red front mechanism braces . . . three screws and three blocks for each brace (C). Locate and install three leveling feet.

Refer to Figure 2. From back of gage, remove two back mechanism braces, also red . . . two screws and one block for each brace (D). Then, remove cap screw and three shipping plates inserted in the gaging mechanism (E). Reattach front and rear cover plates. Note: Allow enough slack in Sensitive Contact Cable ((F), Figure 1) and gage head cord to permit free movement of gaging mechanism. Retain all braces, screws, wire and crate for future use, if necessary.

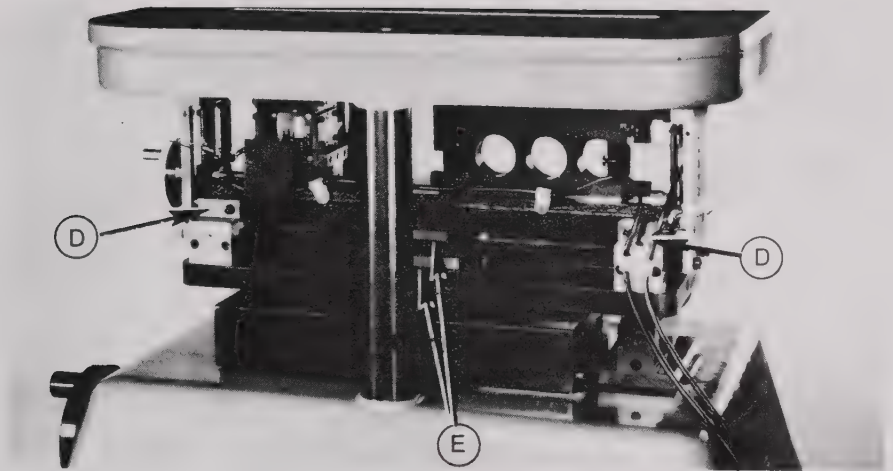


Figure 2. Model 136B-5, Rear View

Refer to Figure 3. Connect Amplifier Mounting Bracket to rear of Comparator, using two 1/4"-28 bolts (A). Mount amplifier, making sure four feet fit securely into corresponding holes in the bracket. Using power cable furnished (B), connect amplifier to the appropriate 117V or 220V ac power source (see power specifications on back panel of the amplifier). Plug in the pantograph null transducer (6-pin connector) (C) and gage head cord (8-pin connector) (D) at the back of the amplifier.

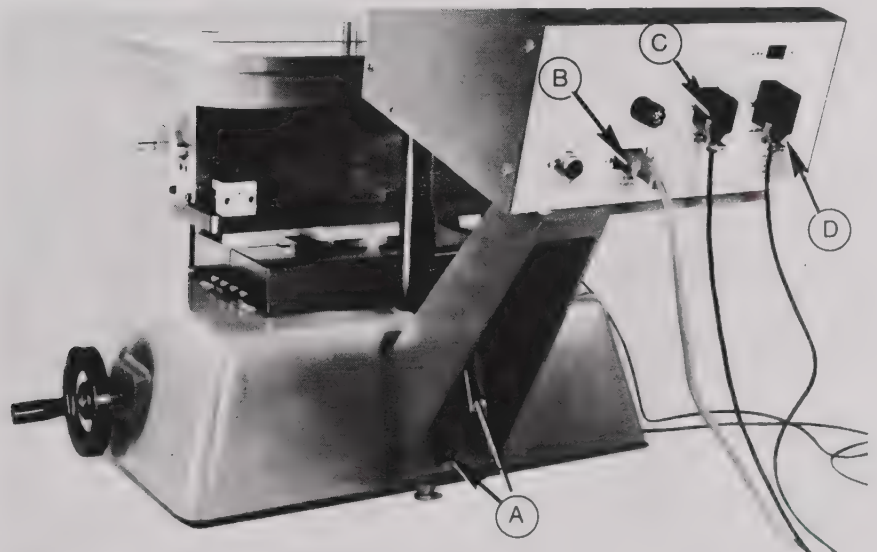


Figure 3. Rear View, Showing Amplifier and Bracket Setup.

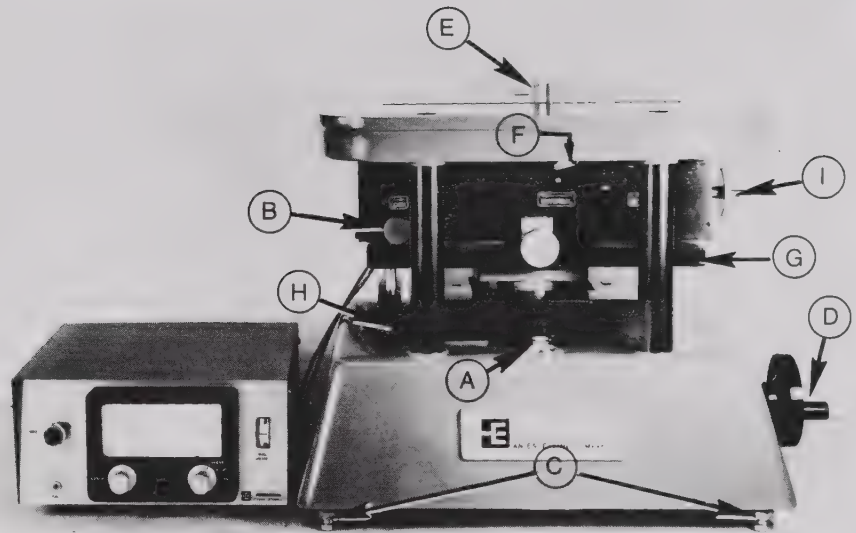


Figure 4. Comparator Operating Controls

Refer to Figure 4. It is important that the comparator be level to allow the gaging mechanism to float properly. A bull's eye bubble level (A) at the front of the gage base aids in determining approximate level. Activate the amplifier by turning Selector Knob to either " μ m" (micrometer) or "IN" (inch) position. Turn the Jaw Lock Knob (B) to "locked" position. Using an open end wrench, adjust the gage legs on front of unit (C) and one leg on rear until the needle on the Null Meter is zeroed (center of scale). Once this is accomplished, it is not necessary for the bubble to be exactly centered.

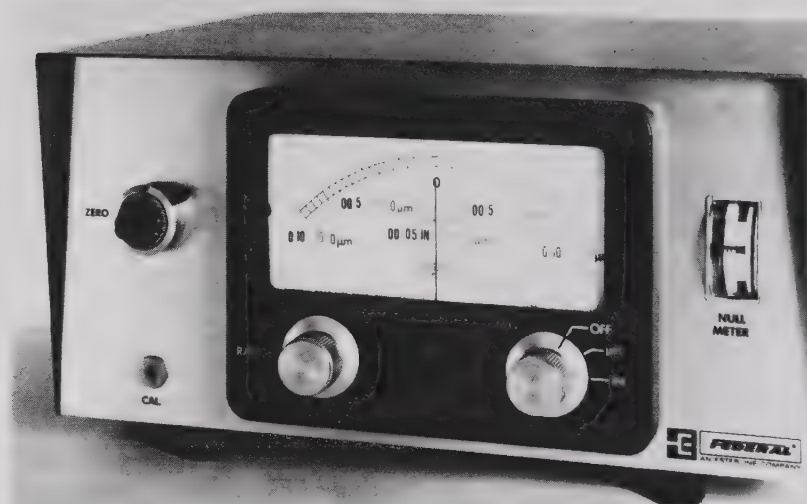
Mounting the Gaging Jaws

Part No	Measuring Capacity	Maximum Measuring Depth
EJW-1002	1.375" to 12.000" I.D./ 35mm to 305mm 0 to 10.750" O.D./0 to 273mm	1.500"/38,100mm 1.693"/43mm
EJW-1003	.365" to 1.375" I.D./ 9,3mm to 35mm	1.375"/35mm
EJW-1004	.250" to .390" I.D./ 6,1mm to 10mm	.690"/17,5mm
EJW-1005	.130" to .275" I.D./ 3,3mm to 7mm	.382"/9,7mm
EJW-1006	.098" to .157" I.D./ 2,5mm to 4mm	.185"/4,7mm
EJW-1007	.050" to .115" I.D./ 1,5mm to 3mm	.170"/4,3mm
EJW-1008	.040" to .078" I.D./ 1mm to 2mm	.110"/2,8mm

The Comparator has gaging capacities of .040" to 12"/1 mm to 305 mm for inside diameters and 0 to 10.750"/0 to 273mm for outside diameters, utilizing seven interchangeable sets of jaws. Each set is marked with its measuring capacity, and each jaw is marked "L" (left) or "R" (right) to indicate its position when mounted in the gage.

To install the jaws, turn Jaw Elevating Wheel (D) to raise the jaw mounting blocks to their highest position (closest to the slot in the measuring table). Reference Jaw "L" (E) mounting block has a selection of tapped holes so that the jaw can be positioned according to the size of the master to be checked. In a majority of cases, the six sets of smaller jaws will be mounted nearest the center of the gage with each contact overhanging the end of the mounting block. To achieve maximum gaging capacity, either I.D. or O.D., the largest set of jaws should be mounted with their contacts toward the outside of the mounting blocks.

Care should be taken when tightening the jaw mounting screws to avoid damaging the gaging mechanism. Be sure jaws are firmly secure, but do not overtighten them.



AMPLIFIER Zeroing

Figure 5. Amplifier Controls

Refer to Figure 5. The amplifier has five individually presented magnification scales. The degree of accuracy and tolerance range of the master to be checked determine which scale is to be used.

With the amplifier on either " μ m" or "IN.", place the Zero Adjust Knob at mid-range. Setup is normally begun on the lowest magnification scale. When the setup is zeroed on the lower scale, the next higher magnification is selected and the zeroing process repeated . . . until the setup has been zeroed on the desired scale. The amplifier scales are precisely correlated; therefore, once zero is set on a higher magnification, it is unnecessary to reset zero when switching to a lower scale.

Calibration With power off, check alignment of meter hand with dial zero. If not exactly on "zero", adjust Pivot Point Adjust Screw until alignment is exactly on "zero". Turn Mode Switch to "IN." position (power is on). Allow the amplifier to "warm up" for several minutes to be certain of complete stabilization.

1. Set the amplifier controls as follows:

Mode Switch IN. (Inch)/ μ m (Metric)
Scale Selector (RANGE) $\pm .001''/\pm 20\mu$ m
Polarity Switch (rear of amplifier) NORM.
Electrical Zeroing Control (ZERO) to No. 5

2. Select three gage blocks which differ in size by $.001''/20\mu$ m (master setting rings of equal equivalent size may be substituted). Place the middle size block in position and adjust gaging jaws mechanically so that the meter reads as closely as possible to "zero". Adjust Electrical Zeroing, if necessary, to achieve alignment.

Note: Refer to Mastering Instructions (beginning on page 9)

3. Substitute the $+.001''/20\mu$ m block and observe any deviation from a plus $.001''/20\mu$ m reading on the meter. If there is a deviation, use CAL potentiometer to bring the meter hand to $+.001''/2\mu$ m. Recheck the "zero" value with the middle size block. If value has changed, repeat step 3.

4. Substitute the $-.001''/-20\mu$ m block and observe any deviation from a minus $.001''/20\mu$ m reading. If adjustments in step 3 agree, no further adjustment is necessary. If there is a deviation, use CAL potentiometer to reduce the deviation by 1/2 its value.

5. Check steps 3 and 4 to be sure end-of-range errors are 1/2 graduation or less on the meter.

6. Set the Polarity Switch (rear of Amplifier) to the REV. position. Fine tune "zero" setting with ZERO control, if necessary, and repeat steps 2 thru 4 (DO NOT adjust CAL potentiometer). Each reading should match the reading obtained in steps 2 thru 4 within the calibration accuracy but at opposite ends of the scale.

TO CHECK
A MASTER RING
(I.D. Measurement)
Gage Blocks

When checking a master ring, gage blocks must first be set in a clamp assembly with end blocks to caliper the gaging contacts. Federal's Gage Block Alignment Kit, EAT-1005, is recommended because it has extra long end blocks and detachable ball feet to facilitate accurate mastering with a gage block stack (rectangular blocks only).

Good gaging practice requires that the gage block combination and master(s) be stabilized at ambient temperature on a heat sink before any measurements be made. Avoid direct handling of the gage blocks and master(s) so that the heat transfer will not affect setup and measurement.

Turn the Jaw Lock Knob to "lock" position (drops into a detent) to prevent any movement of the reference jaw during setup. Put Reversing Lever ((F), Fig. 4) in the "internal" position. Turn the Centralizing Knob ((G), Fig. 4) so that the dot is at "12 o'clock" position, indicating that the jaws are central in the measuring table slot.

Mastering

1. When mastering for I.D. sizes of approximately .500"/13 mm or larger, the gage block combination should be positioned horizontally on the measuring table, parallel with slot. Note that when mastering I.D. sizes from less than .500"/13 mm, gage block combination should be placed on end over gaging jaws. A pair of rails are provided to span the slot in the table. Follow steps 2 thru 9 as outlined below, except gently tap gage blocks to obtain a "zero" on the Null Meter and a MINIMUM reading on the amplifier meter. It is not necessary to use the Swivel Adjustment ((H), Fig. 4) if the gage blocks are tapped into "zero" position.

2. Turn Sensitivity Jaw Adjustment ((I), Fig. 4) so gaging jaws are visually SMALLER than the length of the gage blocks. Turn the Jaw Elevating Wheel so the gaging jaw contacts are aligned with the center of the end blocks.

3. With the amplifier set for the lowest magnification scale,

gently position the left end block in contact with the Reference Jaw (left). Crank the Sensitive Jaw Adjustment to engage the Sensitive Jaw with the right end block of the combination. Continue this adjustment until "near zero" is obtained on the amplifier meter.

4. Gently holding the gage block combination in contact with the Reference Jaw, swivel the combination about the Sensitive Jaw to obtain a MINIMUM reading on the amplifier meter, indicating the true length of the gage block combination. (If the minimum reading is off scale or nearly so, readjust the Sensitive Jaw Adjustment to bring the reading "near zero" on the meter.)

5. Alternately adjust the Swivel Adjustment and the Sensitive Jaw Adjustment until a reading is obtained on the Null Meter. Gently tap the gage block combination in the direction that will bring the Null Meter to "zero" while maintaining the minimum reading on the amplifier meter.

6. With the Null Meter at "zero", adjust the amplifier Zero Adjustment Knob to bring the amplifier meter hand to "zero".

7. Switch the amplifier to the next higher magnification and repeat steps 5 and 6 so that both meters again read "zero". Repeat this process until both meters read "zero" on the magnification scale to be used for measurement.

8. Turn the Jaw Lock Knob to the "Unlock" position (drops into a detent). There should be no shift of the two meter readings, assuring that a true floating (null) setup has been established while the same gaging pressure is being applied to both jaws. If a shift in either meter reading does occur, relock the Jaw Lock Knob and repeat steps 5 and 6 until no shift occurs when switching from "Lock" to "Unlock".

9. Place the Jaw Lock Knob in "Lock" position and carefully remove the gage block combination.

10. Position the master ring to be checked over the gaging jaws. Hold the ring in contact with the Reference Jaw and swivel it about the Sensitive Jaw until a MAXIMUM (true diameter) reading is obtained on the amplifier meter.

11. Turn the Jaw Lock Knob to the "Unlock" position. Alternately tap the ring in the direction of the Null Meter to "zero" and adjust the Centralizing Knob to obtain the MAXIMUM reading on the amplifier meter. This maximum reading indicates the amount of error in the size of the master from the size of the gage block combination. Check for repeat by turning the Jaw Lock Knob to its "Lock" position and back to "Unlock" again. As in step 8 above, there should be no shift of the two meter readings, indicating that "true null" gaging conditions have been maintained.

12. To explore the bore of a master ring at various depths from its face, turn the Jaw Elevating Wheel to raise or lower the gaging jaws to the desired level. Adjust the Centralizing Knob at each elevation to assure that the MAXIMUM reading (true diameter) is obtained. By plotting the readings taken at several elevations, it is easily determined whether such conditions as taper, bell-mouth, barrel shape, etc. exist in the master.

Note: When making measurements on very small inside diameters, care must be taken when using jaws, EJW-1006, 1007 and 1008. These jaws are provided with plates which fit into the slot on the table. The plates permit measuring small parts which otherwise would fall through the slot. Because these jaws are small and fragile, gaging pressure is critical; therefore, be sure to watch the Null Meter to assure equal gaging pressure on the jaws.

TO CHECK
A MASTER DISC
OR PLUG
(O.D. Measurement)

The largest set of jaws is used for all O.D. measurements and should be installed as marked (left and right). Follow the general setup instructions for I.D. measurement, except put the Reversing Lever in the "External" position.

Turn the Sensitive Jaw Adjustment so that the opening between the gaging jaws is visually LARGER than the gage block combination. Insert the gage blocks between the gaging jaws and follow "Mastering" Steps 3 thru 9 to "zero" both the Null Meter and the amplifier meter on the desired scale. Position the master disc or plug between the gaging jaws. Holding it in contact with the Reference Jaw, swivel the disc or plug between the jaws to locate the MAXIMUM (true diameter) reading on the amplifier meter.

Turn the Jaw Lock Knob to the "Unlock" position and alternately tap the disc or plug to bring the Null Meter to "zero". Adjust the Centralizing Knob to maintain the MAXIMUM reading on the amplifier meter. The maximum reading indicates the amount of error in the size of the master from the size of the gage block combination.

Follow the same procedure as outlined under I.D. measurement (page 9). Check for repeat and, if desired, explore the master at various elevations to determine the presence of taper, hourglass, barrel shape, etc.

MAINTENANCE

Amplifier Although most electronic components can be repaired by a competent electronics serviceman, it is strongly recommended that all service repairs be conducted at Federal Products in Providence.

To change the fuse, simply unscrew and replace it with a 3 AG, 1/4 AMP. Slo-Blow replacement.

If the amplifier alone requires service, it may be returned to Federal Products without returning the entire comparator.

Gaging Jaws It is important that the gaging jaws be handled very carefully, especially the smaller sets of jaws which are fragile and can be damaged with rough handling or misuse.

The gaging jaws furnished have been matched for compatibility with this unit only. Therefore, if additional jaws are purchased or if replacement of damaged jaws are needed, they must also be matched to the comparator with which they are to be used. High resolution of readout makes this custom alignment necessary. Alignment of new or replacement jaws may be made in-plant, following instructions provided with each set of gaging jaws.

Comparator Repairs to the gaging mechanism should not be undertaken in the plant. Return the comparator to Federal Products for repair. Repack in original crate, making sure all shipping plates, braces and wire are in place. Reverse procedure for removing shipping materials as described on page 3 of these instructions.

Oxford®

RV-1WE	WHITE
RV-1BK	BLACK
RV-1RB	ROYAL BLUE

MADE IN THE U.S.A.

 **ESSELTE**

MP MASTER



MA33350